University of Pretoria
Department of Economics Working Paper Series

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Moses M. Sichei
University of Pretoria

Working Paper: 2005-10
November 2005

Department of Economics
University of Pretoria
0002, Pretoria
South Africa
Tel: +27 12 420 2413
Fax: +27 12 362 5207
http://www.up.ac.za/up/web/en/academic/economics/index.html

Bank-Lending Channel in South Africa: Bank-Level Dynamic Panel Data Analysis

Moses Muse Sichei

Department of Economics, University of Pretoria, 0002 Pretoria, South Africa
Email: sichei@yahoo.co.uk *or* moses.sichei@up.ac.za

November 21, 2005

Abstract

The paper investigates the bank-lending channel (BLC) of monetary policy in South Africa using quarterly bank-level data for the period 2000Q1-2004Q4. Capital adequacy and bank size are used as indicators for information problems faced by banks when they look for external finance. Utilising dynamic panel estimation methods the study shows that BLC operates in South Africa. The finding has some policy implications. First, there is need to coordinate monetary policy with financial innovations and prudential banking regulations. Second, the overall effects of monetary policy pursued by the South African Reserve Bank cannot be completely characterised by interest rates only.

JEL classification : E5 ;E52 ; G21

Keywords **:** Monetary policy transmission ; Bank-lending channel ; Dynamic panel ; GMM estimator

1.Introduction

Monetary policy transmission mechanisms are the channels through which changes in monetary policy instruments generate the desired policy goals such as economic growth and price stability[1]. Schmidt-Hebbel (2003) highlight some difficulties faced in attempting to identify the transmission channels for monetary policy in emerging economies like South Africa. First, emerging economies are subject to greater volatility and monetary policy regime changes. Second, there is a dearth of empirical studies on emerging countries due to lack of data. Finally, much of economic theory is conceived for industrial countries.

The *Journal of Economic Perspectives* fall 1995 edition contains papers presented in a symposium on monetary transmission mechanisms (Mishkin 1995, Bernanke and Gertler, 1995, and Taylor, 1995). Mishkin (1995) identifies four channels of monetary policy transmission; interest rate channel, credit channel (balance-sheet and bank-lending channel), the exchange rate channel and other asset prices channel. The study focuses on the bank-lending channel (BLC).

Kashyap and Stein (1993) argues that under the lending view of monetary transmission, there are three assets; money, publicly issued bonds and intermediated loans. Under this view, the banks play two roles. They create money and make loans (maturity transformation), which unlike buying bonds the household sector cannot

[1] The other objectives are full-employment, international competitiveness and financial stability.

perform. Specifically, banks are suited to handle certain types of borrowers with high asymmetric information problems e.g. small firms.

In the three-asset world, monetary policy can affect investment not only through its effect on interest rates but also via its impact on the supply of bank loans. Some banks may, however, insulate their loan portfolio from the tight monetary policy by resorting to non-traditional sources of finance. Thus the decrease in bank loans is likely to differ among banks.

There is abundant evidence on the empirical relationship between monetary policy, bank loans and economic activity (Kashyap and Stein, 2000, Kishan and Opiela, 2000, Huang, 2003, Sevestre, Savignac and Loupias, 2002). The general conclusion in most of the studies is that tight monetary policy leads to a drop in bank credit, which has large negative impact on economic activity.

The study employs dynamic panel data approach to test how bank characteristics (capital adequacy and bank assets) in South Africa affect the response of loan supply after a change in monetary policy. The principal finding is that the BLC operates in South Africa.

The rest of the paper is organised as follows. Section 2 briefly reviews monetary policy in South Africa. Section 3 specifies the model. Section 4 deals with estimation

issues while Section 5 reports the results. The main insights and policy recommendations are presented in Section 6.

2. Monetary policy in South Africa

According to Mohr *et al.* (2004:373), monetary policy in South Africa can be divided into five regimes; Liquid-asset based system, mixed system, cost of cash reserves based system with monetary targeting, repurchase agreement (repo) system with monetary targeting and informal inflation targeting, and repo system with formal inflation targeting. These regimes are presented in Table 1. The focus of the study is on the last regime, which uses the repo rate and formal inflation targets.

Figure 1 is a diagrammatic representation of the channels that are likely to be involved in the monetary transmission mechanism in South Africa. Using the current monetary policy regime (last row in Table 1), there are a number of steps in the monetary policy transmission process.

First, a change in the repurchase agreement rate (repo) by the South African Reserve Bank (SARB) affects the market interest rates (rates for deposits and lending), asset prices, expectations and nominal exchange rates.

Table 1
Monetary policy regimes in South Africa

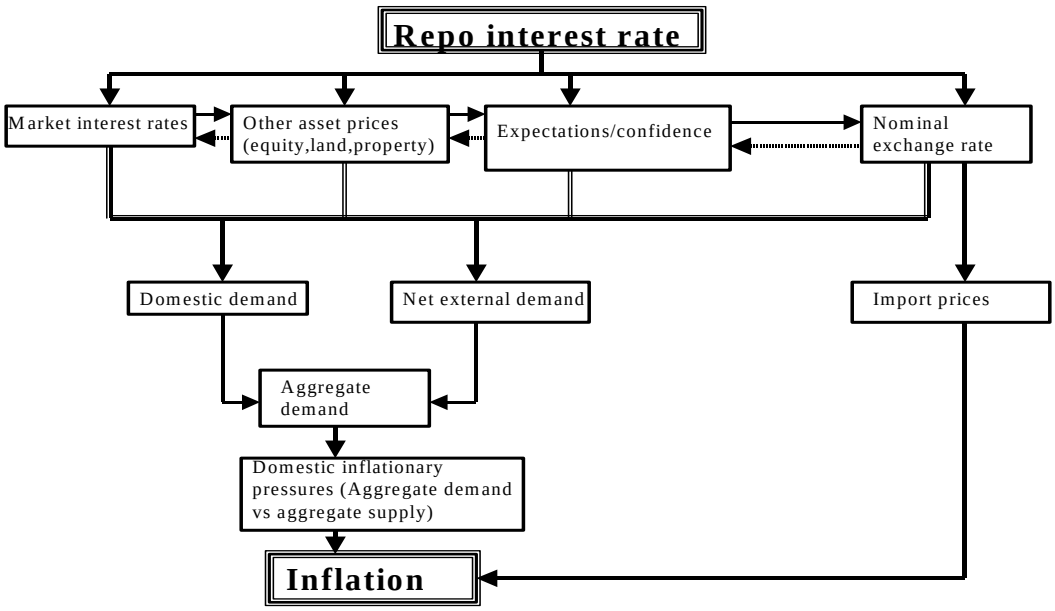
Policy regime	Period	Features

Liquid asset-based system	1960-1980	Quantitative controls on interest rates and credit
Mixed system (Liquid asset-based system and cost of cash reserves-based system)	1981-1985	Liquid asset-based system gradually replaced by cost of cash reserves-based system. Banks held a certain percentage of their liabilities in form of cash reserves with the SARB. The reserves did not earn interest and could be obtained by discounting eligible financial instruments at the SARB's discount rate. Cost of credit to the general public was linked to the SARB's discount rate.
Cost of cash reserves-based system with monetary targeting	1986-1998	Pre-announced targets of money supply (M3) pursued indirectly through changes in the SARB's bank rate. Monetary targets missed due to, among others, financial liberalisation and other structural changes in the economy.
Repurchase agreement (Repo) system, M3 targets and informal targets for core inflation[2]	1998-1999	Repo system coupled with pre-announced targets of money supply (M3) and Informal Targets of core inflation
Repo system with formal targets for CPIX inflation[3]	February 2000-Present	Main instrument used is the repo rate, which is the interest rate that the SARB charges for accommodating the cash needs of commercial banks. A monetary policy committee (MPC) of the SARB meets regularly to consider possible adjustments to the repo rate.

Source: Adapted from Mohr *et al.*(2004:373)

Second, changes in these variables lead to changes in consumption (C) and investment (I) through their impact on the components of the domestic demand and net external demand (exports and imports).

[2] Excludes the prices of fresh and frozen meat and fish; fresh and frozen vegetables; interest rates on mortgage bonds and overdrafts/personal loans; value added tax (VAT); assessment rates by local government.
[3] Excludes interest rates on mortgage bonds.



Source: Adapted from HM Treasury (2003:10) and Smal and Jager (2001:5)

Figure 1. The transmission mechanism of monetary policy

There are four different routes through which monetary policy-induced changes in market interest rates, asset prices, exchange rates and expectations could affect the components of aggregate demand. These are the interest rate channel; the credit channel (bank-lending and balance-sheet channels); exchange rate channel and other asset prices channel.

In accordance with Mishkin (1995) the BLC in South Africa can be schematically presented as follows;

$$\text{Re}\,po \quad rate \uparrow \Rightarrow bank \quad deposits \downarrow, bank \quad loans \downarrow \Rightarrow I, C \downarrow \Rightarrow Y \downarrow, P \downarrow \qquad (1)$$

Equation 1 states that an increase in the repo rate by the SARB curbs bank deposits and demand for loans to finance investment and consumption. Depending on the elasticity of aggregate supply and demand, national income or prices may fall.

One implication of the BLC is that monetary policy has greater effects on small banks, which cannot cushion themselves against tight monetary policy. It also underscores the fact that if prudential regulations allow banks greater ability to raise non-reservable funds (e.g.CD), the potency of monetary policy is impaired.

The focus of this paper is on the BLC. However, there are some points that should be emphasized. First, as pointed out by Mohr *et al.* (2004: 523), the link between the interest rate and investment spending is quite crucial for the BLC. Second, the transmission mechanisms works through various channels and it is not easy to isolate one of them. Third, the outcome of the process is quite uncertain in most cases. Finally, there is always a time lag between the policy action and its eventual impact on the real output (Y) and price level (P).

3. Model specification

The study uses an empirical specification based on Kashyap and Stein (1993);

$$\log Z_{it} = \sum_{k=1}^{2} \beta_{1k} \log Z_{it-k} + \sum_{k=0}^{1} \beta_{2k} \log y_{t-k} + \sum_{k=0}^{1} \beta_{3k} i_{t-k} + \sum_{k=0}^{1} \beta_{4k} X_{it-k} + \sum_{k=0}^{1} \beta_{(5+k)i} (i_{t-k} * X_{it-k}) + u_{it} \quad (2)$$

Hypotheses: $\beta_1 > 0, \beta_2 >, \beta_3 < 0, \beta_4 > 0, \beta_5 > 0$

Z_{it} refers to either total stock of gross loans, total deposits or non-deposit sources of funds for bank *i* at quarter t and. y_t is real GDP to control for demand-side shocks in the economy that affect bank loans.

A prerequisite for a proper test of the BLC is a good indicator of monetary policy in South Africa (i_t). As pointed out by Kashyap and Stein (2000), there is a lot of controversy on this issue. The possible indicators of monetary policy are the change in short term interest rate under the control of the central bank, the residuals from a vector autoregression (VAR) representing the reaction function of the central bank (Bernanke and Mihov, 1998), the narrative approach (Boschen and Mills, 1995). In this paper the repo rate is used as the indicator of monetary policy in South Africa in the period 2000 to 2004 (Table 1).

The i represents the *i*th commercial bank while t captures the *t*th quarter i.e. $t = 2000Q1,...,2004Q4$. The error term is decomposed as a one-way error component model (i.e. $u_{it} = \mu_i + \nu_{it}$). The first component, μ_i, captures the bank specific-effect and takes the form of a bank individual constant. This term encompasses the effect of all explanatory variables such as credit assessment and monitoring skills that differs across

banks but remains constant over time. ν_{it} is an idiosyncratic remainder error term assumed to be white noise. Centred quarterly dummy variables for quarters 1 to 3 are also included. These dummy variables take values of 0.75 and –0.25 otherwise.

A bank's loan supply reaction to monetary policy is assumed to depend linearly on the bank's balance sheet strength (bank characteristics i.e. X_{it}), which can be proxied by bank size (S_{it}) and capitalisation (K_{it}). Bank size and capitalisation are measures of bank's health that affect the external finance premium. These measures are defined as follows;

$$S_{it} = \log A_{it} - \frac{1}{N}\sum_{i=1}^{24} \log A_{it} \tag{3}$$

$$K_{it} = \frac{C_{it}}{A_{it}} - \frac{1}{T}\sum_{t=1}^{20}\left(\frac{1}{N}\sum_{i=1}^{24}\frac{C_{it}}{A_{it}}\right) \tag{4}$$

Where A_{it} and C_{it} are total assets and capital, respectively. Equations 3 and 4 show the normalisation of the bank characteristics with respect to their average across all the banks with a view to computing indicators that sum to zero over all observations. The average of the interaction term $i_t * X_{it}$ is therefore zero and hence the parameters $\beta_{(5+k)}$ in Equation 2 are interpretable as the overall monetary policy effect on the variable being explained (loans, deposits or non-deposit funding related liabilities).

A dynamic panel data model is used for two reasons. First, there is a close banker-customer relationship that develops and may create lock-in effects thus making it costly

for the borrower to change a bank (Rajan, 1992). Thus lagged loans affect current loans. Second, monetary policy only impacts lending behaviour with a lag due to contractual commitments (e.g. floating and fixed charges on movable and immovable assets, respectively). Hence, lagged values of the explanatory variables also affect current loans with a lag.

4. Estimation framework

The dynamic nature of the model in Equation 2 facilitates a better understanding of the dynamics of loan adjustment. However, as pointed out by Baltagi (2001), the dynamic panel data regression in Equation 2 is characterised by two sources of persistence over time; autocorrelation due to the presence of a lagged dependent variable among the regressors and bank-specific effects characterising the heterogeneity among the commercial banks.

The inclusion of the lagged dependent variable renders the OLS estimator biased and inconsistent even if the remainder error term (ν_{it}) is not serially correlated. Nickell (1981) shows that the within estimator will be biased of order $O\left(T^{-1}\right)$ and its consistency depends on T being large. One prominent way to address the problem faced in dynamic panel data has been through the first-differenced generalised method of moments (GMM) estimator as suggested by Arrellano and Bond (1991).

Blundell and Bond (1998) and Kruiniger (2000) highlight some pitfalls of first differenced GMM (Arrellano and Bond, 1991) estimator when using persistent data or

close to random walk. The main problem is that the instruments used in the standard first-differenced GMM estimator become less informative in two cases. First, as β_1 in Equation 2 increases to unity, and second as the relative variance of the fixed effects increases i.e. $\left(\frac{\sigma_\mu^2}{\sigma_\nu^2}\right) \to \infty$. Where $\sigma_\mu^2 = Var(\mu_i)$ and $\sigma_\nu^2 = Var(\nu_{it})$.

Arrellano and Bover (1995) and Blundell and Bond (1998) demonstrate that when $\beta_1 = 1$ the instruments used in first differenced GMM estimators are no longer correlated with the first differences of the regressors. Additionally, some moment conditions become discontinuous at $\beta_1 = 1$ (Kruiniger, 2000).

The alternative approach is the Arrellano and Bover (1995) systems estimator, which exploits an assumption about the initial conditions processes to obtain additional linear moment conditions that remain informative even for persistent series[4]. This method transforms the data using orthogonal forward deviation (Equation 25 in Arrellano and Bover, 1995). This transformation subtracts the mean of the remaining future observations available in the sample from each of the forward (T-1) observations.

This transformation has a number of important characteristics. First, it eliminates bank-specific effects and keeps the orthogonality among the transformed errors. Second, since the rows of the transformation matrix add up to zero, the permanent effects are eliminated. Finally, the transformation matrix is upper triangular so that lags of

[4] Most variables in this study are persistent (Table 6 in the appendix).

predetermined variables are valid instruments in the transformed equations. Blundell and Bond (1998) demonstrate that the systems estimator results in substantial efficiency gains and reduced bias, particularly with persistent data.

5. Estimation results

The study uses a sample of 24 banks out of 38 in existences as at December 2004. The selection of the estimation period (2000Q1 to 2004Q4) is predicated on the need to test BLC within one single monetary policy regime in South Africa (repo system and inflation targeting in Table 1). Capitalisation adequacy and bank size are used to discriminate banks according to their external finance costs.

There are two conditions for the BLC to work in South Africa. First, there should be bank-dependent customers in South Africa. Second, monetary policy by the SARB should be able to affect the supply of loans so that the decrease in loan supply depresses real aggregate spending in South Africa. The first condition generally holds in South Africa in the formal economy. Therefore the focus is on testing the second condition. The study begins by first testing the prerequisite conditions for the SARB to be able to affect loan supply.

5.1 The effect of monetary policy on deposit mobilisation

The first question that needs to be answered is do banks in South Africa experience a fall in deposits following a monetary contraction? Columns 3 and 6 of Table 2 present

the results for the effect of monetary policy on bank deposits using capital adequacy and bank size to discriminate banks. The Sargan over-identifying restriction confirms the validity of lagged levels dated t-3 to t-5 as instruments.

First, the results show that an increase in the repo rate significantly reduces bank deposits in South Africa (Equation 1). Thus tight monetary policy is inimical to the deposit mobilisation function of commercial banks in South Africa.

Second, bank deposits increase by 1.8 per cent following 1 per cent increase in real GDP. This is consistent with expectation since a booming economy would tend to have many economic agents with excess savings, which commercial banks can mobilise.

Third, the effect of bank characteristics on deposits differs. On one hand an increase in bank capital-asset ratio beyond the banking industry-wide average (Equation 4) leads to a reduction in deposits. This finding is expected given the fact that banks with high capital asset-ratio have less deposits (Tables 4 and 5 in the appendix). On the other hand an increase in bank size (Equation 3) leads to an increase in deposits. This is a confirmation of the fact that large banks have large deposits (Tables 4 and 5).

Finally, the joint effects of the repo rate and bank characteristics (capital-asset ratio and bank size) are insignificant implying that the level of deposits falls uniformly regardless of differences in balance sheet strength (information asymmetry). Thus, in

general deposits tend to fall following tight monetary policy, which satisfies one of the conditions of BLC.

5.2 The effect of monetary policy on non-deposit sources of finance

The second question is can banks in South Africa replace the tight monetary policy-induced lose in deposits by other sources of funds? To answer this question the non-deposit funding related liabilities from the private sector is used to proxy other sources of funds. Columns 4 and 7 of Table 2 present the results that attempt to answer this question. The Sargan over-identifying restriction confirms the validity of lagged levels dated t-3 to t-5 as instruments.

First, using capitalisation, an increase in the repo rate has a significant negative effect on non-deposit funding related liabilities. However, using bank size the repo rate has no effect on non-deposit funding related liabilities.

Second, an increase in real GDP leads to a reduction in non-deposit funding related liabilities. This can be rationalised by the fact that robust economic activity is associated with high deposits implying reduced need to seek other sources of finance.

Third, banks, which are highly capitalised, seek less non-deposit funding related liabilities from the private sector. However, large banks tend to seek more non-deposit funding related liabilities.

Table 2
Orthogonal forward deviation transformation GMM estimation results

	Capital adequacy			**Bank size**		
	Loans	**Deposits**	**Other funding liabilities**	**Loans**	**Deposits**	**Other funding liabilities**
Loans (-1)	0.934***			0.811***		
	(27.699)			(23.350)		
Deposits(-1)		0.398***			0.449***	
		(16.273)			(98.162)	
Other funding liabilities (-1)			0.245***			0.245***
			(8.951)			(11.091)
Repo rate	-0.018***	-0.020***	-0.285***	-0.027***	-0.015***	0.101
	(-2.653)	(-3.749)	(-2.807)	(-3.739)	(-6.247)	(1.104)
Real GDP	-0.512***	1.833***	-31.163***	-0.393**	1.803***	-30.006 ***
	(-7.062)	(9.193)	(-14.714)	(-2.313)	(16.302)	(-21.746)
Real capital	-6.086***	-4.668***	-43.039***			
	(-3.380)	(-3.902)	(-4.029)			
Real capital*repo rate	0.682***	-0.007	0.243			
	(3.531)	(-0.088)	(0.207)			
Bank size				0.389***	0.509***	3.725**
				(4.448)	(10.164)	(3.842)
Bank size*repo rate				0.021**	-0.003	-0.159***
				(2.591)	(-0.549)	(-3.293)
Quarter 1 dummy		0.158***	-2.349***		0.139***	-2.634***
		(10.580)	(-11.823)		(18.202)	(-18.606)
Quarter 2 dummy		0.073***	0.142		0.071***	-0.010
		(5.706)	(0.586)		(8.918)	(-0.119)
Quarter 3 dummy		0.024**	-1.000***		0.015***	-1.006***
		(2.366)	(-16.235)		(2.902)	(-13.187)
Diagnostic statistics						
Adjusted R-squared	0.549	0.415	0.048	0.58	0.615	0.118
Instrument rank	25.000	24.000	24.000	24.000	24.000	24.000
Sargan J statistic	23.472(0.217)	19.886(0.225)	16.821(0.397)	21.789(0.295)	20.920(0.182)	18.621(0.289)

Notes: (i) *, ** and *** are 10%, 5% and 1% significance levels, respectively. (ii) Instrumentation: Lagged dependent variable dated $t-3$ to $t-5$

Finally, the joint effects of contractionary monetary policy and bank characteristics differ. On one hand capital-asset ratio is insignificant implying that the level of non-deposits funding related liabilities falls uniformly regardless of differences in capital (information asymmetry). On the other hand contractionary monetary policy leads to increased levels of non-deposit funding related liabilities. Thus the reserve bank is unable to effectively control the non-deposit funding related liabilities from the public.

5.3 The effect of monetary policy on bank loans

Having confirmed the conditions for BLC, the actual test is performed in the columns 2 and 5 of Table 2. BLC exists if the coefficients associated with the joint effects of the repo rate and bank characteristics are positive. A non-significant coefficient may indicate either absence of BLC or that the chosen bank characteristic does not appropriately discriminate banks in South Africa according to their external finance cost.

First, the coefficient for the repo is significantly negative, which is consistent with the interest rate channel and shows that bank loan supply falls as monetary policy tightens and vice versa.

Second, there is a negative relationship between real GDP and bank loans. This is inconsistent with expectation implying that banks tend to lean against the tide. Thus recessions are characterised by banks trying to lend so as to prop up businesses and vice versa.

Third, the partial effect of bank characteristics is ambiguous. Capital-asset ratio has a significant negative effect on bank loans while bank size has a significant positive effect. This is not surprising given the descriptive statistics in Tables 4 and 5 in the appendix where it is apparent that small banks tend to have high capital-asset ratio.

Fourth, the joint effect of monetary policy and bank characteristics is significantly positive implying that banks with strong balance sheets in terms of capital-asset ratio and total assets can cushion the effects of tight monetary policy on their loan portfolio. This effectively confirms the presence of BLC in South Africa. This finding is consistent results from the US (e.g. Kashyap and Stein, 2000, Kishan and Opiela, 2000), who find that size and capitalisation have significant impact on bank lending.

6. Conclusions

The aim of the paper was to check the existence of BLC in South Africa over the period 2000Q1 to 2004Q4. This period was selected on account of same monetary policy regime (i.e. inflation targeting and repo system). The study employs capital adequacy and bank size to discriminate banks. The Arrellano and Bover (1995) estimation framework is used since it is robust to persistent data.

Using both bank size and capital-asset ratio the study finds that BLC operates in South Africa. The finding of BLC has a number of implications (Kashyap and Stein (1993).

First, monetary policy has distributional consequences in the banking sector. Specifically, the cost of tight monetary policy might fall more on small banks and their customers. These distributional considerations may be important when formulating monetary policy in South Africa.

Second, the fact that large banks in South Africa can cushion the effects of tight monetary policy on their loan portfolio implies that financial innovations and prudential bank regulations can affect the potency of monetary policy. Thus there is need to co-ordinate of prudential bank regulation, financial innovations and monetary policy. Increase in the size of banks in South Africa may drive a wedge between monetary policy conducted by SARB and the banking system. This policy recommendation has implication for the deal between ABSA Bank and Barclays bank (Table A.1)[5]. The resultant banking conglomerate may use its huge capital base to cushion the effects of tight monetary policy.

Finally, using the repo rate as a measure of cost of financing may give a misleading picture of the extent to which investment in different sectors is influenced by monetary policy.

[5] Barclays bank Plc is to invest 33 billion rands in Absa bank.

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Appendix

A.1 Description of variables

Capital and reserves: Net qualifying capital and reserve funds and Non-qualifying capital and reserve funds including impairments.

Total assets: Central bank money and gold; investments including trading portfolio assets; non-financial assets and other assets.

Loans: Other private sector loans and advances; foreign currency loans and advances. Specific and general provisions for bad and doubtful debts are included.

Deposits: Deposits denominated in rands and deposits denominated in foreign currency.

Total funding related liabilities: loans and advances given to the bank including repo payments; other liabilities to the public.

The individual bank variables are collected from Banks' D1900 Returns at the SARB (http://www.reservebank.co.za).

Real GDP (2000=100), CPI (2000=100) and *repo rate* are collected from historical data download facility at the the SARB (http://www.reservebank.co.za)

A2. Descriptive analysis

Table 4
Basic bank characteristics (Average during 2000Q1-2004Q4)

Bank	Capital & Reserves	Total assets	Total deposits	Non-deposit funding related liabilities	% Capital-asset ratio	Total loans
ABN Amro Bank	293.3	5220.2	4420.1	403.0	5.8	4054.9
ABSA Bank	15018.0	192857.4	146018.6	17084.5	7.7	46271.4
African Bank	1755.4	5638.0	1070.7	2556.8	31.2	4664.5
Albaraka Bank	47.1	567.0	490.3	16.0	8.3	86.4
Barclays Bank	149.3	5138.1	3623.3	895.4	2.9	2795.2
Bank of Baroda	58.7	145.7	13.9	74.2	41.2	103.5
Bank of Taiwan	78.7	866.2	667.5	110.9	10.0	819.9
Calyon Bank	256.8	10755.8	9521.9	375.1	2.6	5975.8
Citi Bank	834.5	20641.1	16658.2	280.8	4.3	11250.6
Commerzbank Aktiengesellschaft	353.8	4288.1	2753.3	906.0	8.3	3575.8
First Rand Bank	11578.4	171053.3	114341.3	22617.3	6.7	45223.1
GBS Mutual Bank	29.1	275.6	238.2	0.0	10.4	7.2
Habib Overseas Bank	13.7	195.8	169.0	7.5	7.1	82.0
HBZ Bank	52.0	375.6	306.1	4.3	15.2	145.7
Imperial Bank	912.4	7449.0	6055.8	27.5	13.4	374.3
Investec Bank	8373.3	56663.3	7650.3	34625.6	14.7	23046.9
Marriot Merchant Bank	103.8	548.8	427.6	0.0	19.0	141.9
MEEG Bank	65.6	575.6	492.5	5.7	11.8	145.9
Mercantile Bank	295.2	2648.6	2086.1	140.6	10.5	1305.3
NEDCOR Bank	14581.1	162926.6	119689.9	10087.8	8.9	49038.6
SA Bank of Athens	51.8	411.7	338.0	12.7	12.6	230.0
Societe Generale Johannesburg	86.7	1569.2	1306.4	88.1	7.2	653.5
Standard Bank	14686.5	202347.5	135730.7	19238.3	7.6	56970.0
VBS Mutual Bank	23.1	158.2	132.2	3.0	14.8	9.4

Source: Data from the South African Reserve bank

Notes: All the variables are in real million rands

Table 5
Correlation between important bank variables

	Capital & Reserves	Total assets	Total deposits	Non-deposit funding related liabilities	% Capital-asset ratio	Total loans
Capital & Reserves	1.00					
Total assets	0.98	1.00				
Total deposits	0.95	0.99	1.00			
Non-deposit funding related liabilities	0.81	0.74	0.63	1.00		
% Capital-asset ratio	-0.16	-0.22	-0.24	-0.09	1.00	
Total loans	0.98	0.99	0.97	0.77	-0.23	1.00

A.3 Panel unit root test

The need to test for unit root in panel data emanates from the fact that a regression equation with integrated variables is likely to be spurious (unless there is cointegration). Panel-based unit root tests have higher power than unit root tests based on individual time series.

The test for panel unit roots can be classified into two groups. The first class of tests assume that the autoregressive parameters are common across banks. The Levin, Lin, and Chu (2002) and Hadri (2000) tests employ this assumption. The first tests employ a null hypothesis of a unit root while the last test uses a null of no unit root.

The second class of tests allows the autoregressive parameter to vary across the cross-sections (banks). The Im, Pesaran, and Shin (2003), among others employ this assumption.

Table 6
Panel unit root tests

Variable	LLC statistic	IPS w-stat	Hadri z- test
Real total loans	0.454	1.22	6.486***
	(0.675)	(0.869)	(0.000)
Real bank size	-1.704**	-0.616	7.508***
	(0.044)	(0.269)	(0.000)
Real capital adequacy	-3.789***	0.028**	5.386***
	(0.000)	(0.038)	(0.000)
Nominal repo rate	-6.373***	-6.202***	5.585***
	(0.000)	(0.000)	(0.000)
Real deposits	1.000*	-0.253	7.154***
	(0.055)	(0.400)	(0.000)
Real non-deposit funding related liabilities	1.000*	-0.253	7.154***
	(0.055)	(0.400)	(0.000)

Notes:

(i)* , ** and *** denotes rejection of null at 10%, 5% and 1% significance levels, respectively.
(ii) Sample: 24 banks, 2000Q1- 2004Q4
(iii) All equations use individual effects and individual trends
(iv) LLC-Levin, Lin and Chu (2002), IPS-Im, Pesaran and Shin (2003), Hadri-Hadri (2000)
(v) p-values in parentheses

The tests show that the variables are non-stationary.